The modules **200**A, **200**B can include one or more optics assemblies **250**. The optics assemblies can be attached to an assembly **240** that is composed of the transparent covers **226** (including the FFL correction layer **232** and the filter layer **230**, if present) and non-transparent walls/spacers **228**, **236**, **239**. Each optics assembly **250** can include, for example, a stack of one or more injection molded optical elements (e.g., lenses) **252** placed in a lens barrel **254**. In some cases, an array of injection molded lens stacks can be provided collectively for all the optical channels (see FIG. **12**A), whereas in other implementations, a separate lens stack is provided for each respective channel (see FIG. **12**B).

Multiple assemblies **240** including transparent covers **226** (together with the FFL correction layer **232** and/or the filter layer **230**) and non-transparent walls/spacers **228**, **236**, **239** can be fabricated as part of a waver-level process. For example, to fabricate assemblies **240**, a process similar to the one described in connection with FIGS. **5**A-**5**E can be used, except that instead of lenses being formed on the transparent wafer, a FFL correction layer is provided on the transparent wafer. The FFL correction layer may be composed, for example, of a glass or polymer material, and can be applied, for example, by spin coating, spraying or sputtering. An optical filter layer may be applied to the other side of the transparent wafer. The spacers and walls for the modules can be formed using the techniques described in detail above (e.g., replication or vacuum injection, trench formation and filling of the trenches with non-transparent material). Transient substrates (e.g., UV dicing tape, a PDMS substrate, a glass substrate, a polymer wafer) can be used to support the structure during the foregoing steps. In some cases, a lens may be replicated on the surface of the optical filter layer. Further, if an optical filter layer is not provided on the transparent wafer, then in some cases, a lens may be replicated directly on the surface of the transparent wafer.

Next, optics assemblies (i.e., lens stacks) can be attached to the object-side of the spacer/optics/embedded transparent cover assemblies. This can be accomplished either on a wafer-level scale or by attaching individual lens stacks to the spacer/optics/embedded transparent cover assemblies. Next, the focal length (e.g., FFL) of each optical channel can be measured and compared to a specified value. If the measured FFL for particular channel deviates from a desired value, the FFL correction layer can be removed selectively in that channel to correct for the FFL value. Photolithographic techniques can be used, for example, to partially or entirely remove the FFL correction layer, as needed. Since the channels may have different FFL values, different amounts of the channel FFL correction layer may be needed to achieve corrected FFL values for the various channels. For some channels, no FFL correction may be needed. In other cases, a portion of the channel FFL correction layer may be removed. In yet other cases, no portion of the channel FFL correction layer may be removed. Thus, depending on the implementation, the channel FFL correction layer may be present for all of the channels or for only some of the channels. Furthermore, the thickness of the final channel FFL correction layer may vary from one channel to the next, depending on the amount of FFL correction needed in each channel.

The wafer-level structure (including the spacers, embedded transparent covers, and optics assemblies) then can be separated into individual assemblies, each of which includes, for example, an array of optical channels. Each of the separated assemblies then can be attached to an individual image sensor assembly (i.e., a PCB substrate on which is mounted an imager sensor).

In some implementations, it may be desirable to provide an optical filter **230**A directly on the active photosensitive regions **223** of the image sensor **222**. Such filters can be provided, for example, instead of the filters **230** on the transparent cover **226**. This arrangement may be useful, for example, where a lens is replicated on the surface of each transparent cover **226**.

Each of the modules of FIGS. **12**A and **12**B includes multiple optical channels. Single modules that include similar features can be provided as well. An example of such a module **200**C is illustrated in FIG. **12**C. The sidewalls of the transparent cover **226** as well as the sidewalls of the optical filter **230** are encapsulated by the non-transparent material of the spacer **228**. The module **200**C also includes an optics assembly implemented as a stack of one or more injection molded optical elements (e.g., lenses) **252** placed in a lens barrel **254**. In the illustrated example, the module **200**C does not include an FFL correction layer **232**.

As illustrated in the examples of FIGS. **12**A and **12**B, the bottom of the spacer **228** extends to, and is in contact with, the upper surface of the image sensor **222**. In some instances, however, as shown in the module **200**D of FIG. **12**D, the bottom of the interior part **228**A of the spacer **228** between the two adjacent optical channels does not extend to the upper surface of the image sensor **222** (or to the upper surface of the optical filter **230**A, if present). The bottom of the interior part **228**A of the spacer **228** between the two channels may, thus, not be in contact with any surface. Further, in some implementations, the optical filter **230**A, if present, can be formed as a contiguous coating that spans both channels. In other cases, each channel may have an optical filter **230**A that has different optical properties from the filter in the other channel.

The optical filters discussed above can be implemented in various ways. For example, in some implementations, a dielectric band-pass filter can be applied to the photo sensitive surface of the light sensing element (e.g., an image sensor) or to a surface of the transparent cover that is disposed over the light sensing element. In some cases, such a band-pass filter is deposited onto the transparent cover (or onto a transparent wafer in the case of a wafer-level process) by vapor deposition or sputtering. Preferably the dielectric filter is deposited onto a transparent cover composed, for example, of glass, sapphire or another transparent material that has mechanical/thermal-expansion properties similar those of glass or sapphire. The band-pass filter can be advantageous because it permits a very narrow range of wavelengths to impinge on the light sensing element (e.g., a photodiode or image sensor). An example of a module **300** that incorporates a dielectric band-pass filter **230**B on the surface of the transparent cover **226**A in the optical detection channel is illustrated in FIG. **13**.

The module **300** of FIG. **13** includes two optical channels: an optical emission channel and an optical detection channel. The emission channel includes a light emitting device (e.g., a LED or laser diode) **222**B, and the detection channel includes a light sensing device (e.g., a photodiode or image sensor) **222**A. The devices **222**A, **222**B are mounted on a common PCB or other substrate **224**. Each channel includes a respective transparent cover **226**A, **226**B that intersects the optical axis of the channel. The side edges of the transparent covers **226**A, **226**B can be covered by or embedded within non-transparent material, in accordance with the techniques described above. The transparent cover **226**B in the emission channel may include one or more optical elements (e.g., a lens) **244** on its surface. Likewise, the transparent cover **226**A in the detection channel includes a dielectric band-pass filter **230**B on its surface. The range of transmission of the band-pass filter **230**B may be selected to match substantially the